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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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*Ex parte* YUEGANG ZHANG

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Appeal 2007-3438  
Application 10/761,575  
Technology Center 2800

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Decided: March 26, 2008

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Before JOSEPH F. RUGGIERO, ANITA PELLMAN GROSS, and  
MAHSHID D. SAADAT, *Administrative Patent Judges*.

GROSS, *Administrative Patent Judge*.

DECISION ON APPEAL  
STATEMENT OF THE CASE

Zhang (Appellant) appeals under 35 U.S.C. § 134 from the Examiner's Final Rejection of claims 17 through 19 and 21 through 31, which are all of the claims pending in this application. We have jurisdiction under 35 U.S.C. § 6(b).

Appellant's invention relates to a transistor with plural nanotubes between the source and drain regions, with each nanotube having open,

functionalized ends with attached functional groups. Claims 17 and 23 are illustrative of the claimed invention, and they read as follows:

17. A transistor comprising:

a source region;

a drain region;

a plurality of nanotubes extending between said source and drain regions, said nanotubes having functionalized ends with attached functional groups; and

a gate electrode over said nanotubes.

23. A transistor comprising:

a source region;

a drain region;

a plurality of open ended nanotubes extending between said source and drain regions; and

a gate electrode over said nanotubes.

The prior art references of record relied upon by the Examiner in rejecting the appealed claims are:

Pfefferle	US 2003/0148086 A1	Aug. 07, 2003
Luyken	US 2003/0148562 A1	Aug. 07, 2003
Nihey	US 2004/0238887 A1	Dec. 02, 2004

(filed Jun. 25, 2002)

Claims 17 through 19, 21, and 28 through 31 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Nihey.

Claims 22 through 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nihey in view of Luyken.

Claims 22 through 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nihey in view of Pfefferle.

We refer to the Examiner's Answer (mailed May 11, 2007) and to Appellant's Brief (filed October 17, 2006) and Reply Brief (filed March 26, 2007) for the respective arguments.

### SUMMARY OF DECISION

As a consequence of our review, we will reverse the anticipation rejection of claims 17 through 19, 21, and 28 through 31 as well as the obviousness rejection of claims 22, 26, and 27 over Nihey in view of Luyken and of claim 27 over Nihey in view of Pfefferle. However, we will sustain the obviousness rejections of claims 23 through 25 over Nihey in view of Luyken and of claims 22 through 26 over Nihey in view of Pfefferle. We also enter a new ground of rejection of claims 17 through 19 under 35 U.S.C. § 103 over Nihey in view of Pfefferle.

### OPINION

The Examiner asserts (Ans. 3-4) that Nihey's statement (paragraph 0029) that "[t]he carbon nanotubes have opposite ends electrically connected to the source electrode and the drain electrode" anticipates the claimed nanotubes having functionalized ends with attached functional groups, as recited in independent claims 17 and 28. The Examiner asserts (Ans. 7-8), "Based on a broad scope of claims, functional groups are any groups that provide functions. ... [S]ource and drain are different functional groups

(providing different functions in transistor) that are attached to the nanotubes." Appellant contends (Br. 10) that "'functionalized' and 'functional groups' are well known terms of art meaning the part of a compound that takes part in reactions." Accordingly, Appellant contends (Br. 10) that Nihey fails to disclose functionalized ends or attached functional groups. The first issue before us, therefore, is whether Nihey can reasonably be interpreted to include nanotubes having functionalized ends with attached functional groups.

Independent claims 17 and 28 recite "functionalized ends with attached functional groups." Dependent claims 21 and 31 recite "functionalized ends coupled to said drain regions" and "functionalized ends coupled to said source regions." Thus, the functional ends of the nanotube cannot be the source and drain regions, as asserted by the Examiner, since they are coupled thereto. Furthermore, "functional groups" is a term of art that is known to mean the reactive part of a compound, and the examples given in the Specification on page 6, lines 15-17, support such a definition of the term. Since Nihey makes no mention of functional groups at the ends of the nanotubes, we cannot sustain the anticipation rejection of claims 17 through 19, 21, and 28 through 31.

The Examiner (Ans. 5-6) rejects claims 22 through 27 as obvious over Nihey in view of Luyken. The Examiner asserts (Ans. 5) that although Nihey does not expressly state whether the nanotubes are capless or open-ended, making the ends of the nanotubes open-ended would have been obvious in view of Luyken's disclosure (paragraph 0038) that "[t]he ends of the nanotubes used in the field-effect transistor may optionally be open or closed." Appellant contends (Br. 10-11) that merely because open-ended

nanotubes are known does not render their use in transistors obvious. The second issue before us, therefore, is whether the use of open-ended nanotubes would have been obvious in Nihey's transistors.

We first note that claims 22, 26, and 27 recite functionalized ends with functional groups, which we found lacking from Nihey. Further, Luyken fails to remedy this deficiency, as Luyken makes no mention of functional groups. Accordingly, we cannot sustain the obviousness rejection of claims 22, 26, and 27.

Claims 23 through 25, however, do not recite functionalized ends. Claims 23 through 25 merely require a transistor with nanotubes between the source and drain, wherein the nanotubes are open-ended. Nihey does not mention whether the nanotube ends are open or closed. Luyken discloses that in a transistor, nanotubes can have open or closed ends. Since there are only two possibilities, and Luyken discloses that they are equal alternatives, the use of either would have been obvious in Nihey's transistors. *See KSR Int'l v. Teleflex Inc.*, 127 S. Ct. 1727, 1742, (2007). Therefore, we will sustain the obviousness rejection of claims 23 through 25 over Nihey in view of Luyken.

The Examiner (Ans. 6-7) further rejects claims 22 through 27 as obvious over Nihey in view of Pfefferle. The Examiner asserts (Ans. 6-7) that although Nihey does not expressly disclose whether the nanotubes are capless or open-ended, Pfefferle "discloses nanotubes with ends being capless/open-ended and being functionalized as improved nanotubes with controllable physical and electronic characteristics that can be used in transistor." Appellant contends (Br. 11) that merely because open-ended nanotubes are known does not render them obvious to use in transistors.

Accordingly, the last issue before us is whether the use of open-ended nanotubes in transistors would have been obvious in view of Pfefferle.

Pfefferle (paragraph 0006) discloses that the object of invention is to produce nanotubes with better defined chemical and physical properties for use in electronic and sensing applications. In the summary of invention, Pfefferle discloses (paragraphs 0010-0011) nanotubes with open ends that can be functionalized for use in a sensor and that the nanotubes can be used in transistors. Pfefferle (paragraphs 0070-0072) more specifically discloses the use of nanotubes in transistors. Further, Pfefferle discloses (paragraph 0071) that the ends of the nanotubes may be exposed and functionalized. Although not particularly clear, Pfefferle at least suggests that functionalized open ends of the nanotubes provide improved chemical and physical properties in transistors. Since Nihey uses nanotubes in transistors, it would have been obvious in view of Pfefferle to make the ends of the nanotubes open-ended and to functionalize them. Accordingly, we will sustain the obviousness rejection of claims 22 through 26 over Nihey in view of Pfefferle. However, we will reverse the obviousness rejection of claim 27 over Nihey in view of Pfefferle, since claim 27 requires that the source and drain functionalized ends of the nanotubes be different, and we find nothing on this record to suggest making the source and drain, and therefore the two ends of the nanotubes, different from each other.

Under the provisions of 37 C.F.R. § 41.50(b), we enter the following new ground of rejection against Appellant's claims 17 through 19 under 35 U.S.C. § 103 as unpatentable over Nihey in view of Pfefferle. As explained *supra*, Pfefferle suggests functionalizing the ends of nanotubes used in transistors for improved chemical and physical properties.

Therefore, it would have been obvious to functionalize the ends of the nanotubes of Nihey. Consequently, claims 17 through 19 would have been obvious over Nihey and Pfefferle.

### ORDER

The decision of the Examiner rejecting claims 17 through 19, 21, and 28 through 31 under 102(e) is reversed. The decision of the Examiner rejecting claims 22 through 27 under 35 U.S.C. § 103(a) is affirmed as to the obviousness rejection of claims 23 through 25 over Nihey and Luyken and of claims 22 through 26 over Nihey and Pfefferle and reversed as to the obviousness rejection of claims 22, 26, and 27 over Nihey and Luyken and of claim 27 over Nihey and Pfefferle. In other words, the Examiner's decision is affirmed-in-part. In addition, we have entered a new ground of rejection for claims 17 through 19 under 35 U.S.C. § 103.

Regarding the affirmed rejection(s), 37 C.F.R. § 41.52(a)(1) provides "Appellant may file a single request for rehearing within two months from the date of the original decision of the Board."

In addition to affirming the Examiner's rejection(s) of one or more claims, this decision contains a new ground of rejection pursuant to 37 C.F.R. § 41.50(b) (effective September 13, 2004, 69 Fed. Reg. 49960 (August 12, 2004), 1286 Off. Gaz. Pat. Office 21 (September 7, 2004)). 37 C.F.R. § 41.50(b) provides "[a] new ground of rejection pursuant to this paragraph shall not be considered final for judicial review."



37 C.F.R. § 41.50(b) also provides that Appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new ground of rejection to avoid termination of the appeal as to the rejected claims:

(1) *Reopen prosecution*. Submit an appropriate amendment of the claims so rejected or new evidence relating to the claims so rejected, or both, and have the matter reconsidered by the Examiner, in which event the proceeding will be remanded to the Examiner. . . .

(2) *Request rehearing*. Request that the proceeding be reheard under § 41.52 by the Board upon the same record. . . .

Should Appellant elect to prosecute further before the Examiner pursuant to 37 C.F.R. § 41.50(b)(1), in order to preserve the right to seek review under 35 U.S.C. §§ 141 or 145 with respect to the affirmed rejection, the effective date of the affirmance is deferred until conclusion of the prosecution before the Examiner unless, as a mere incident to the limited prosecution, the affirmed rejection is overcome.

If Appellant elects prosecution before the Examiner and this does not result in allowance of the application, abandonment or a second appeal, this case should be returned to the Board of Patent Appeals and Interferences for final action on the affirmed rejection, including any timely request for rehearing thereof.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

Appeal 2007-3438  
Application 10/761,575

AFFIRMED-IN-PART  
37 C.F.R. § 41.50(b)

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